

Title: Toy Factory

Brief Overview:

Students will improve their ability to recognize the relationship of patterns to multiplication. They will gain an understanding of multiplication and patterns and the relationship between the two. Students also will create their own toy design using pattern blocks to solve numerical problems in real-life situations. Science and social studies will be integrated into this unit so students will learn about mathematics in contexts outside of mathematics.

Links to NCTM 2000 Standards:

- **Standard 1: Number and Operation**

Mathematics instructional programs should foster the development of number and operation sense so that all students understand numbers, ways of representing numbers, relationships among numbers, and number systems; and understand the meaning of operations and how they relate to each other;

- **Standard 2: Patterns, Functions, and Algebra**

Mathematics instructional programs should include attention to patterns, functions, symbols, and models so that all students understand various types of patterns and functional relationships; use symbolic forms to represent and analyze mathematical situations and structures; and use mathematical models and analyze change in both real and abstract contexts.

- **Standard 6: Problem Solving**

Mathematics instructional programs should focus on solving problems as part of understanding mathematics so that all students build new mathematical knowledge through their work with problems; develop a disposition to formulate, represent, abstract, and generalize in situations within and outside mathematics; apply a wide variety of strategies to solve problems and adapt the strategies to new situations; and monitor and reflect on their mathematical thinking in solving problems.

- **Standard 7: Reasoning and Proof**

Mathematics instructional programs should focus on learning to reason and construct proofs as part of understanding mathematics so that all students make and investigate mathematical conjectures; and select and use various types of reasoning and methods of proof as appropriate.

- **Standard 8: Communication**

Mathematics instructional programs should use communication to foster an understanding of mathematics so that all students organize and consolidate their mathematical thinking to communicate with others; express mathematical ideas coherently and clearly to peers, teachers, and others; extend their mathematical knowledge by considering the thinking and strategies of others; and use the language of mathematics as a precise means of mathematical expression.

- **Standard 9: Connections**

Mathematics instructional programs should emphasize connections to foster an understanding of mathematics so that all students recognize and use connections among different mathematical ideas; understand how mathematical ideas build on one another to produce a coherent whole; and recognize, use, and learn about mathematics in contexts outside of mathematics.

- **Standard 10: Representation**

Mathematics instructional programs should emphasize mathematical representations to foster an understanding of mathematics so that all students create and use representations to organize, record, and communicate mathematical ideas; and use representations to model and interpret physical, social, and mathematical phenomena.

Links to National Science Education Standards:

- **Unifying Concepts and Processes**

Students will demonstrate their ability to create and organize patterns with function tables and explain those processes. Students will create toys from patterns and explain the toy's functions.

Grade/Level:

Grades 3-4

Duration/Length:

Approximately 3 class periods, 45 minutes to 1 hour in length, for activities.
2 class periods, 45 minutes in length for The Toy Factory performance assessment.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Skip counting by 2, 3, 4, 5, and 10
- Basic understanding of multiplication: (3 X 5 means 3 groups of 5)
- Calculators-knowledge of how to use the constant key
- Some experience with describing and creating patterns with pattern blocks

Student Outcomes:

- Students will be able to:
- write multiplication sentences to represent a repeated mathematical pattern.
- use various types of patterns and function tables to gain an understanding of the relationship between patterns and multiplication.
- demonstrate their ability to solve multiplication problems using patterns and function tables.
- represent, explain, and describe the mathematical relationship of patterns to multiplication in verbal and written forms.
- use patterns to produce products for science and social studies.
- create and use function tables to organize and record mathematical patterns.

Materials/Resources/Printed Materials:

- Pattern blocks and overhead pattern blocks
- Aluminum foil
- Paper and scissors
- Long strip of paper
- Student resource sheets
- Overhead of student resource sheet
- Laminated large function table

Development/Procedures:

Day 1

- Ask one student to stand up. Ask the class, “How many eyes does the student have?” Write the number two on the board.
- Ask one more student to stand. Ask the class, “How many eyes do the two students have?” Write the number four on the board.
- Continue to have one more student stand up and repeat the procedure for the entire class.
- Tell the students to examine the numbers on the board. Ask the class, “What can you tell me about these numbers?” (Answers should include: a pattern, counting by two’s, even numbers, skip counting by two’s, and possibly the 2x multiplication table.
- Ask why this is a pattern? Review vocabulary: core, term, and sequence.
- Repeat activity with body parts that come in two’s. After each person stands up, write the multiplication sentence that corresponds with the number of students x 2. For example, 3 students x 2 ears = 6 ears.
- Brainstorm with class about other body parts that they could use to skip count.
- Tell the class they are going to skip count their fingers by 5’s using their hands.
 - Each student will trace their hand on a piece of paper, write their name on it, and cut it out.
 - One student at a time tapes their paper hand to a long strip of paper. The students write the corresponding multiplication sentence on their hand. Hand one ($1 \times 5 = 5$), hand two ($2 \times 5 = 10$),...
 - The class checks the multiplication sentences as each student writes their multiplication sentence on their paper hand.
 - Have students stand and count their fingers by 5’s to check the final product.
 - Repeat procedure counting by 10’s.
- Have students complete Student Resource 1.

Day 2

- Introduce a game called “Bizz”. Students count 1,2,3,4, Bizz, 6,7,8,9, Bizz. At each multiple of 5, the students say bizz instead of the number. If a student makes a mistake he is out of the round. The game continues until one student is left.
- Review the vocabulary: pattern, core, term, and sequence.
- Write several patterns on the board and have students extend the patterns.
- Divide the class into groups of 3 to 6 students.
- Pass out Student Resource 2.
 - Guide students in constructing aluminum rings and completing the function table.
 - Examine the function table and discuss the patterns formed.
 - Have students write a minimum of two patterns that they see in the table.
 - Have students share their written responses and explain.

Day 3

- Play “Bizz” again.
- Have students brainstorm skip counting patterns and write them on the board. Students call on another student to extend their pattern. Ask students to describe how skip counting patterns relate to multiplication.
- Pass out pattern blocks and allow for exploration time.
- Pass out Student Resource 3.
 - Have students complete activity independently.
 - Give guidance only as needed.
- Share correct responses for Student Resource 3 on the overhead, when students have completed the assignment. Have students reflect and assess their responses.

Performance Assessment:

The Toy Factory performance assessment, Student Resource 4, is to be given on Days Four and Five. This assessment is to be completed independently by the students. The scoring tool is found at the end of the performance assessment. The teacher first may want to model a “toy” for the students before giving out the assessment.

Extension/Follow Up:

- Display student’s final function tables and picture of toy design.
- Compare, contrast, and discuss patterns.
- Students can construct a multiplication pattern to match a given product.
- Students can design a repeated pattern with beads for a Native American necklace in Social Studies.
- The Toy Factory could relate to a Social Studies Economics Unit.
- The Toy Factory could relate to a Physical Science Invention Unit.

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Student Resource 1

Name _____

Date _____

Draw a picture to solve. Write the multiplication sentence that tells how many in all.

Five students are in the Math Center. Draw a picture to show how many legs are in the Math Center. Write the multiplication sentence that tells how many legs are in the Math Center.

Eight students are in the swimming pool. Draw a picture to show how many toes are in the swimming pool. Write the multiplication sentence that tells how many toes are in the swimming pool.

Name _____ Date _____

Reading to Perform a Task: Multiplication Patterns

Today we will be making aluminum foil rings to use as holiday decorations. You will need to follow the directions carefully to construct the rings.

1. Roll your aluminum foil to look like a hot dog.
2. Make a circle out of your hot dog by connecting the two ends.
3. Fold or twist the two ends together to keep them in place.

How many rings has your group constructed? _____

4. Fill in the function table on the next page.
5. Follow steps 1-3 to construct another ring. Connect each new ring to the previous ring(s) to make a chain.

How many rings has your group constructed in all? _____

6. Fill in the function table on the next page.

We will repeat steps 5 and 6 a few more times.

Function Table

Rings per student	# of students	# of rings in all	Multiplication sentence

Look at the function table you have completed. In the space below, write at least two different patterns you see in the table.

Name _____ Date _____

Reading to Perform a Task: Multiplication Patterns

Today we will be using pattern blocks to build a tree. You will need to follow the directions carefully and completely fill in the function table.

1. Place the triangle on your desk.
2. Place the trapezoid directly under the triangle, with the longest side of the trapezoid on the bottom.
3. Place the square directly under the trapezoid. Your shape should look like an evergreen tree.
4. Look at the function table on the next page. Tree #1 information has been completed for you.
5. Construct another tree just like the first tree.
6. Complete the function table for tree #2. You will need to fill in the number of blocks in all and the multiplication sentence.
7. Construct a third tree just like the first two trees. Complete the function table for tree number three.
8. Construct a total of 10 trees. Each time you construct a new tree, fill in the function table.
9. When you have made all 10 trees and filled in the function table, answer the question underneath the function table.

Function Table

Tree #	# of blocks in tree	# of blocks in all	Multiplication sentence
1	3	3	$1 \times 3 = 3$
2	3		

Look at the function table above. Explain how you used the number of trees, number of blocks in each tree, and number of blocks in all to write your multiplication sentence.

Name _____ Date _____

Performance Assessment: Toy Factory

The Toy Factory needs new toy designs to stock their factory stores. Mr. Toys 4U has asked you and your partner to design a toy for his factory. After the toy is designed, you will need to write Mr. Toys 4U and tell him how many parts he will need to order to make 9 of your toys.

Now read the directions carefully to design, construct, and order your parts for your toy.

Activity 1

1. Select 10 or fewer pattern blocks. Use these blocks to design a toy.
2. Record the number of pattern blocks you used in your toy design on the function table on the next page. Record the total number of pattern blocks and the multiplication sentence.

For example, if you used 2 pattern blocks in your design, your function table would look like this:

# of toys	# of blocks in toy	# of blocks in all	Multiplication Sentence
1	2	2	$1 \times 2 = 2$

3. Construct another toy just like the first toy.
Complete the function table for toy number 2.
4. Construct a third toy just like toys 1 and 2.
Complete the function table for toy number 3.
5. You need to construct a total of 9 toys. Every time you make a new toy, you will also need to fill in the function table. If you do not have enough pattern blocks, you may trace the blocks or use the patterns on the table to determine the total number of blocks.
6. Trace one of your toys below.
7. Give your toy a name. Write one sentence to describe what your toy does.

Name of toy:

What does the toy do?

Draw a picture of the toy by tracing the pattern blocks:

Function Table

# of toys	# of blocks in toy	# of blocks in all	Multiplication sentence

Activity 2

Turn the page and read the instructions for writing the letter.

Toy Factory

Mr. Toys 4U has agreed to use your toy design in his store. He has decided to start by making 9 of your toys. If the toys sell well, he will order more of your toy design for his toy store.

Write Mr. Toys 4U a letter that tells him how many pattern blocks to order for 9 of your toys and how you used patterns and multiplication to find your answer.

Be sure to include:

- Name and description of toy
- Number of pattern blocks needed to create 9 toys
- The patterns that are formed on the function table
- How the patterns that are formed on the function table are related to multiplication

Scoring Tool

- 3 - name and description of toy
 - number of pattern blocks needed to create 9 toys
 - at least 3 patterns that are formed on the function table
 - clear explanation of how the patterns relate to multiplication

- 2 - name and description of toy
 - number of pattern blocks needed to create 9 toys
 - at least 2 patterns that are formed on the function table
 - somewhat clear explanation of how the patterns relate to multiplication

- 1 - name or description or number of pattern blocks needed to create 9 toys
 - at least 1 pattern that is formed on the function table
 - unclear explanation of how the patterns relate to multiplication

- 0 - off topic
 - no patterns described
 - no explanation of how patterns relate to multiplication